

# Roadsides

An FHWA Quarterly Newsletter for Roadsides Decision-Makers

*This issue is devoted to: Drought and Vegetation Management Insights*

## EFFECTS OF DROUGHT ON WEED MANAGEMENT

Steven Dewey

Utah State University

**H**ave you ever noticed that weeds seem more abundant or more difficult to control under dry conditions? Well, its not just your imagination. Many weeds have developed ingenious ways to survive and even thrive under conditions that would kill many other plants. When drought conditions persist, many desirable plants are weakened or even killed, and weeds fill in the spaces to take over. Why are some weeds able to cope so well with drought? Some have unusually long roots that permit them to reach water stored deep in the soil where some desirable plants can't reach (i.e. leafy spurge, field bindweed, and Russian knapweed). Some weeds keep their extensive root system in the top few inches of soil and absorb water very quickly, essentially giving them first rights to any precipitation (i.e. downy brome, kochia, and yellow starthistle). When rainfall is light and infrequent, there is often none left over for plants whose roots majority of roots are deeper. Other weeds can become dormant during of extreme heat and drought – a little bit like hibernating – allowing them to avoid the harsh effects (i.e. hoary cress and quackgrass). Still other weeds are able to germinate, grow, and produce seeds very quickly, taking advantage of scarce precipitation and completing their life cycle before other plants (i.e. Russian thistle, shephers purse, and wild mustard). Whatever the reason, weeds usually win in the battle for limited resources like water.

Drought can also affect the performance of many herbicides. Soil-active herbicides normally need precipitation to move into the soil where they can be taken up by weed roots. If the soil is dry and no precipitation occurs, herbicides may remain on the soil surface, ineffective and vulnerable to loss. One of the recommendations to minimize the effects of drought on soil-applied herbicides is to mechanically incorporate the materials shallowly as soon as

possible after application.

Foliage-active herbicides also are frequently affected by drought. Dry soil and air conditions make it especially difficult for herbicides to get into plants and move about because they adversely affect the processes known as absorption and translocation. Foliar absorption refers to the passage of herbicide molecules from the outer surface of a leaf, through the protective covering called the cuticle, and into the living cells inside the leaf. Cuticles are layers of waxes and resins that cover the surface of all leaves and stems of most plants to protect them against excessive evaporative water loss. Cuticles typically become much thicker and more difficult for herbicides to penetrate when drought conditions exist. Absorption of some herbicides can be improved under drought conditions by the addition of specific adjuvants listed on their labels.

Translocation is the movement of herbicides through vascular tissues to various places within a plant. When weeds are stressed by drought, herbicide translocation is often affected, moving more slowly and perhaps not as far as if applied under good moisture conditions. Because control of perennial weeds from a foliar-applied herbicide depends much on translocation to distant roots or rhizomes, its no surprise that control can be reduced.

As a general rule, herbicides work best if applied when environmental conditions are favorable for plant growth. Whenever possible, avoid applying herbicides when weeds are under stress. Always read and follow all label instructions regarding environmental conditions that can affect the performance of the herbicides you use.

NOTE: Per the author, invasive plants that often increase or spread during drought include leafy spurge, squarrose knapweed, diffuse knapweed, Scotch thistle, hoary cress, jointed goatgrass, yellow starthistle and kochia. Plan accordingly. ☘



Star thistle one of the invasive increasers during dry conditions.



Leafy spurge also takes advantage of drought.

# DUST BOWL LESSONS....QUICK FIXES CAN HAVE LONG TERM CONSEQUENCES.

Bonnie L. Harper-Lore

**T**he drought of the 1930's or "Dust Bowl" was the ecological equivalent of the collapse of the stock market, and its reverberations were felt across the country. As "Black Thursday" came to connote financial disaster, so the phrase the "dirty thirties" described the distress of the land, in particular the fragility of the topsoil. (Phoebe) As the blowing topsoils of the West landed on the steps of the Capitol in the East, the New Deal administration reacted in three ways:

1. Prohibited further homesteading by dedicating remaining land to controlled grazing,
2. Pulled out of production 11.3 million substandard acres, and
3. Began planting a transcontinental wind break.

The consequences of 65 years of grazing on public lands are well known. I suspect many of the 11.3 substandard acres were moved into production as irrigation technology improved. But a transcontinental windbreak....what were they thinking!

## PRAIRIE STATES FORESTRY PROJECT

They used the best information they had at the time; BUT planting a windbreak from Canada to Mexico that would keep soils blowing from the west in the West, seems ludicrous still.

Let's examine the border to border wind break idea. Instead of determining the causes of this remarkable erosion event, we attempted a band-aid solution of a symptom of poor farming practices. It was doomed from the start. The Prairie States Forestry Project included farmstead windbreaks, public land block plantings, and farm strip plantings. Although the plantings were considered a grand example of applied ecology; the plantings were oriented east-west rather than north-south. The plantings included many non-native species with seed imported far from other countries. The 1935 prototype included Chinese elm, Russian olive and caragana. All of these are now known weed problems. In addition, black locust became the most widely planted tree seed, moving it far from its original range in the Appalachian Mountains. Demand for black locust was so great its seed was imported from abroad! Subsequently, a seed industry developed in the Northwest that could handle orders of 100,000 pounds of black locust seeds. . We did the best we could with the information of the time; but did not foresee the consequences.

There were also positive consequences. Although the Forestry Project did not stop the loss of topsoil, shelterbelts did supply shade, beauty, less dust, and protection from cold. Shelterbelts around farmsteads



Black locust was widely planted during the dust bowl

continue to be used in this way. Although the windbreak itself did not stop soil loss, this report became the basis for silviculture in the Great Plains. The Project has been cited as "a remarkable example of applied ecology".

The demand for seeds and tree cuttings for this project generated businesses and jobs. Technology advances in propagation, refrigeration of stock, and field equipment improved. In the summer of 1934, many CCC camps were assigned to the Soil Conservation Service to carry out the work. But by 1936 Congress refused to continue the project's funding. For more details of this project note the references below.

(U.S. Forest Service, 1935)

# DUST BOWL LESSONS....QUICK FIXES CAN HAVE LONG TERM CONSEQUENCES.

## INTRODUCTION OF KUDZU....a "problem solver" from another land

Meanwhile in the southeast, between 1935 and 1941, some 73 million seedlings of Kudzu, an introduced Japanese vine, were planted to curb soil erosion on millions of acres of farm land. Before this massive planting, farmers had called it the porch vine because of the quick shade it was able to provide. That knowledge of the vine's potential impacts were not considered. With growth rates up to a foot per day, Kudzu has swallowed telephone poles, abandoned houses, tree and gullies. Just as the plains' shelterbelt was ineffective, the kudzu's performance was far too successful. Neither black locust-dominated shelterbelts or kudzu erosion control plantings have lessened erosion across the country. The solution still lies in thoughtful farm practices. Because of increased economic pressures on farmers, there is increased pressure to put more erosion-susceptible lands into production.

To this day, Kudzu persists throughout the southeast as its most invasive plant species. In the thirties we could not predict the consequences of a rapidly-growing, exotic vine. Science is now able to predict invasiveness. We also have learned from our past mistakes. Looking for problem-solving plants on our own continent has become ecologically smart. Unfortunately soil erosion continues to be a huge problem and we still do not address the causes well enough to prevent soil loss. Erosion controlling vegetation is only part of the solution. No-till farming is another. We have much to learn in the trend towards conservation farming begun in the 50's.

If another drought occurs, we will need to be aware of and use our best science thoughtfully. For once the winds become dusty, the people will call for solutions. Let's be sure we do not repeat the quick fixes used in the dirty thirties. (Cutler)

## CURTIS PRAIRIE RESTORATION PROJECT.....planting native grasses and forbs.

The Dust Bowl era, with its inarguable message of environmental devastation, had persuaded the Roosevelt administration of the urgency of land rehabilitation. (Stephanie Mills, 1995.) Consequently, after the drought one of Roosevelt's CCC camps was enlisted to work on one of the first examples of rehabilitation or restoration at the University of Wisconsin's Arboretum. With the help of the CCC, Ted Sperry, and Aldo Leopold, the John Curtis prairie was begun in 1934. Many of the lessons learned from this experiment apply to roadside revegetation efforts today.

Because the Curtis Prairie Restoration, believed to be the oldest in the world, is on University land, this project is likely the most closely monitored. What has been learned during the past decades is the most importance of:

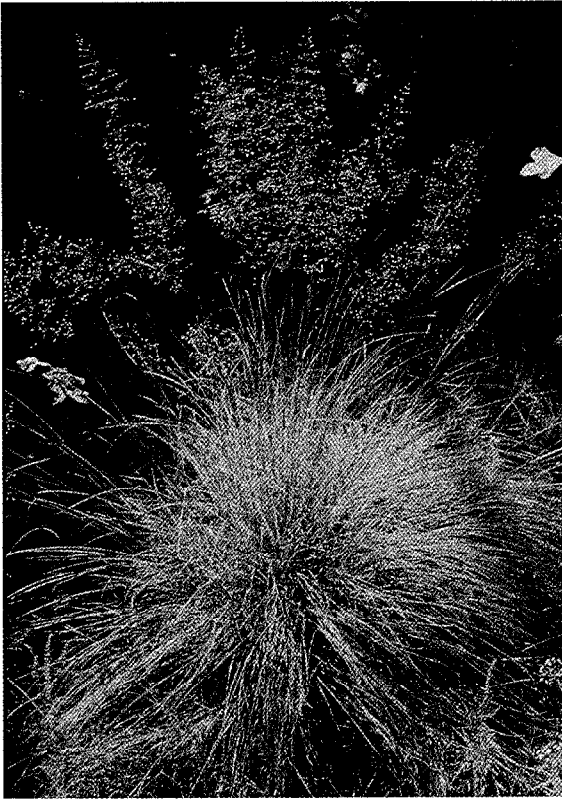


Kudzu, planted as a problem solver, became a bigger problem.

1. weed removal during site preparation - to this day the weed species like sweet clover that were on the former agricultural site continue to persist. Elimination of invasive weeds during site preparation appears to be critical to success in the long run.
2. planting diversity - Unless a project is surrounded by a quality natural area (the Curtis Prairie is surrounded by an suburban environment), the only species you will find years later, are the ones you planted. Therefore, it is important to plant as much diversity as is available and that you can afford at the time. Adding diversity years later, has not been shown to be successful.
3. vegetation management - the Curtis Prairie is as successful as it is, because of continued maintenace. Management of existing weeds through pulling, cutting, spraying and burning have provided opportunities for learning, as well as one of the most successful prairie plantings done so far. Roadside plantings will need spot treatments to ward off noxious weeds. ☛

# DUST BOWL LESSONS....QUICK FIXES CAN HAVE LONG TERM CONSEQUENCES.

## WEAVER RESEARCH PROJECT



Prairie dropseed survives long term with a complex network of surface roots.

It was no accident that John Weaver was monitoring the prairies during the drought years. For forty years, he and his students monitored "that portion of the prairie that has "resisted civilization" longest". What he learned during the dust bowl years has lessons for us today.

"Precipitation had been somewhat deficient and drought periods occurred in 1931 and 1933 when moisture was not available to the roots of plants in the surface foot of soil. This however, had little effect upon the (prairie) vegetation. Then came the summer of 1934 when drought was the greatest ever recorded in true prairie. This offered an exceptional opportunity to study the response of the native plants to extremely adverse water relations." (J.E.Weaver, 1954)

"No rain fell; clouds were rare.....The light was intense: the dust-filled, yellow, western sky in evening portended another day of drought. The hot southerly winds blew as from a desert

drought that had bleached the green hilltops to patches of brown alternating with white, now crept down the slopes. The persistence of the grasses and forbs was remarkable. Only after days of wilting and rolling or folding of the leaves, weeks of battling the intense heat, high winds, and low humidities under the cloudless skies, did life finally retreat underground to wait the advent of rain." By this point the fields of wheat, clover and corn were long gone. Weaver continued to examine 30 prairies in Iowa, Nebraska, and Kansas throughout the drought.

During the first year of drought more bare soils were exposed and the open spaces were filled by both introduced and native plant species. The invasive plants that increased under these conditions included: peppergrass, horseweed, and hairy chess. Some native forbs also acted as opportunists. Many-flowered aster, daisy fleabane, sleepy catchfly and Venus' looking-glass, wild onion, dogtooth violet, Carolina anemone, smooth goldenrod, sage, and yarrow outnumbered the grasses in many locations. Of the native grasses, Western wheatgrass was the greatest increaser. Buffalo grass and blue grama took advantage of the dieback of taller plants. The above-ground prairie looked different. But the below-surface system held on.

After seven years of drought, the dust storms finally stopped blowing. The Kentucky bluegrass found throughout the native pastures before the drought, had with rare exception, entirely disappeared west of the Missouri River. Little bluestem, buffalograss, June grass, along with tall dropseed decreased in abundance. Side-oats grama, considered highly drought-resistant, survived the best of the native grasses. Plains muhly, a western drought-resistant grass, migrated eastward. Switchgrass, nodding wild-rye, and cordgrass held on in wet places, but were replaced by big bluestem and western wheatgrass in areas that dried. The landscape

had noticeably changed.

The forbs or wildflowers decreased sporadically. Deep rooted plants like prairie rose, lead-plant, blazing star and false boneset held out the best. By 1940 most species of forbs had decreased greatly.

And why? Did they not go dormant or into survival mode? What was happening underground?

Infiltration of water was part of the problem. Increased bare soils led to less infiltration. Soil under native prairie grasses absorbed water more rapidly than soil covered by western wheatgrass. With less available water the prairie had been replaced by more xeric prairie plants.

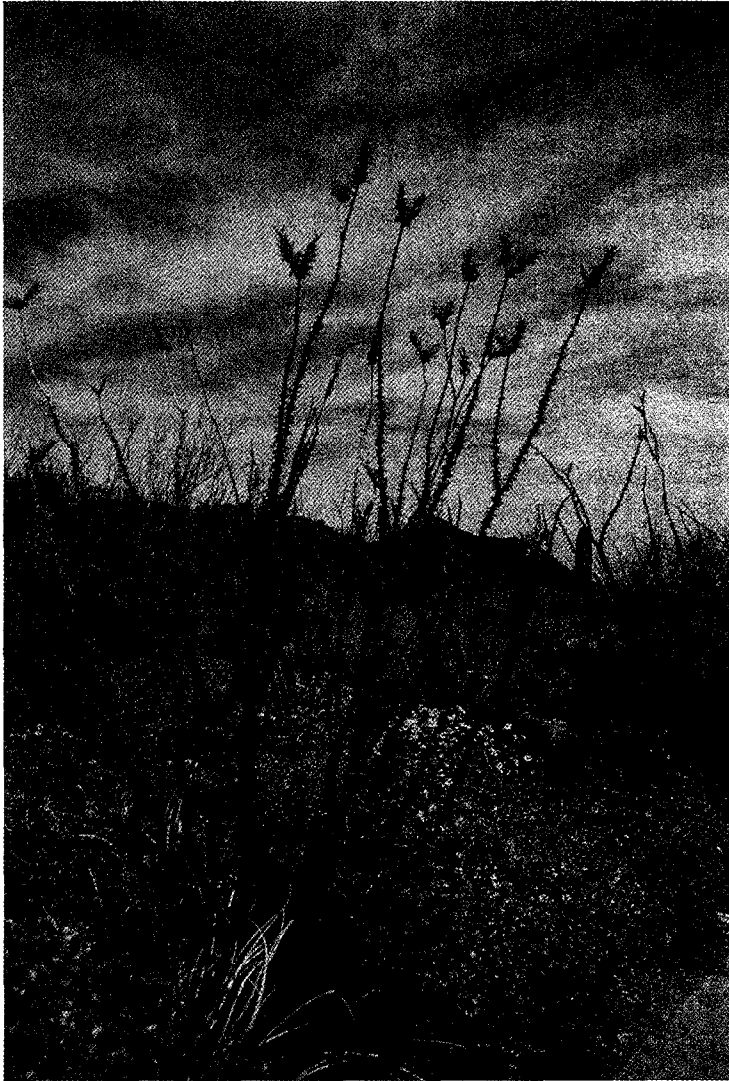
The overall appearance of the tall grass prairie had changed to a mixed-grass prairie with shorter xeric plants replacing some tall species. Dormancy saved the diversity of the grassland. It took two to three years for the prairie to repair its cover. The bared soils were repopulated and recovered.

This stable prairie endured the disturbance caused by drought like it had done through other catastrophes of fire, flood and frost, just as it was adapted to do.

These drought tolerant plants have application to harsh roadside conditions. They are the low-growing, herbaceous, perennial ground cover that prevent soil erosion, accommodate wildlife, add seasonal variety, outcompete invasive weeds, and survive drought, floods, and more. Although most of the prairie ecosystem was historically located west of Ohio, every State has native grasslands in their natural heritage, and meadow remnants within their boundaries. Learn from these stable, drought-tolerant, cold hardy, self-reliant plant communities and especially protect any remnants that still exist on rights-of-way.

They will be useful to you over time and climate change. ☘

## DROUGHT AFFECTS DESERT TOO



In spite of adaptations, deserts also suffer under drought conditions.

### CITATIONS:

J.E. Weaver, 1954. *North American Prairie*, Johnson Publishing Company, Lincoln, Nebraska.

J.E. Weaver and T.J. Fitzpatrick, 1934. *Ecological Monographs*, Volume 4 "The Prairie", Duke University Press, Durham, North Carolina.

Mitchel P. McClaran and Thomas R. Van Devender, Eds., 1995. *The Desert Grassland*. The University of Arizona Press, Tucson.

Gary Paul Nabhan, 1982. *The Desert Smells Like Rain*. North Point Press, New York.

The desert grassland, a naturally arid plant community, found in Arizona, New Mexico and Texas also was impacted by the dustbowl days. The grassland is shaped by low rainfall, warm temperatures and high solar radiation. Evapotranspiration (soil evaporation and plant transpiration) is regularly two to three times greater than the rainfall. A mosaic of grassland and desert scrub tolerates this environment under normal conditions.

In spite of this community's adaptation, add the stress of drought as occurred in the late 1800's and drastic change followed - enough change to stir interest in revegetation of desert grasslands.

"Although the drought was the precipitating factor, early researchers placed the blame for the decline of perennial grasses squarely on overgrazing, which weakened grass root systems, making them unable to withstand drought, set seed for regeneration or recover when precipitation finally arrived." Revegetation with native forage grasses was begun near Tucson, Arizona in 1907.

As decline during drought occurred, invasive plants, many of which were unpalatable by cattle, increased on this landscape. The undisturbed native grasses and forbs were credited with having deterred the invasion before the drought. With grasses and forbs decreasing, the mesquite tree was substituted for stock feed. The mesquite then invaded former grasslands. By the 30's its control was begun. Because of these invasions in grasslands, research management with fire began in the 1950's. We learned that this somewhat stable grassland could not withstand grazing and drought pressure all at the same time.

(McClaran and Van Devender, 1995) ☺

Poebe Cutler, *The Public Landscape of the New Deal*.

U.S. Forest Service, 1935. *Possibilities of Shelterbelt Planting in the Plains Region*. Lake States Forest Experiment Station, St. Paul, Minnesota

John Steinbeck, 1939. *The Grapes of Wrath*. The Viking Press Inc.

USGS, 2000. *Drought Watch*. [WWW.USGS.GOV/drought/us](http://WWW.USGS.GOV/drought/us).

# DROUGHT TOLERANT VEGETATION



Jewelweed is adapted to respond to dry conditions on a daily basis.

*Evelyn Howell, University of Wisconsin*

One of the predicted consequences of global warming is an increase in extreme weather patterns, including widespread incidents of prolonged drought. The prospect of water shortages raises questions about how plants respond to water stress, and how we might use this information in proactive roadside management. Precipitation patterns vary widely across the earth, and over time, plants in different regions have adapted several ways through their root systems by osmosis. Osmosis is the movement of water across a membrane by diffusion, from

solutions with relatively low concentrations of dissolved chemicals (soil water) to solutions with high concentrations (the cells of the roots). Some plants maintain high concentrations of molecules and ions in their root cells to facilitate diffusion of water from the soil, as water supplies become scarce. Competition for water is one explanation given for the pattern of distribution of roots in the soil. Soil pit excavations of prairie soils, for example, reveal a complex network of surface roots (grasses such as prairie dropseed, *Sporobolus heterolepis heterolepis*), and long deep tap roots (wild indigo,

*Baptisia lacteata*, for example). Different species occupy different depths, and sometimes one plant will have roots at several distinct layers.

The transport of water from roots to shoots is accomplished by “transpirational pull”, a process that is very similar to what happens when you drink soda through a straw. Plants have a system of water conducting tubes - the xylem elements — running from the roots through the stems and forming the veins of the leaves. The veins are connected to the photosynthetic tissues of the leaf, most of which are separated from the outside air by a layer of epidermis (the skin of the leaf)

which is covered by a waxy cuticle. This protective barrier is interrupted by a series of tiny pores, the stomata, which can open and close. When the stomata are open, dry air on the outside of the plant causes water to evaporate from the leaf tissue. As the water molecules are pulled from the plant through the stomata, they pull the column of water up the xylem tubes from the roots, which in turn pull water and dissolved mineral nutrients from the soil.

Just as you would imagine, one way that plants deal with water shortage is to close the stomata, thereby interrupting transpiration. This turns out to be only a short-term solution, however, because the stomata also are the means by which oxygen and carbon dioxide (gasses that are essential for photosynthesis and respiration) are exchanged.

Thus plants must maintain a delicate balancing act. Open stomata allow gasses to be exchanged and facilitate the uptake of water, but keep them open too long and excessive water loss may occur.

Some desert plants have developed an elegant solution to the problem of stomatal water loss. This adaptation is made possible by the development in some desert plants of an alternative photosynthetic pathway, nicknamed CAM. Typically, photosynthesis requires a supply of carbon dioxide to be readily available as the plant cells capture light. This generally means that the stomata need to be open during the heat of the day. These desert plants open their stomata in the cool of the night to allow gas exchange at a time when rates of water loss are slowed and close them during the day,

# DROUGHT TOLERANT VEGETATION

when water stress is high.

CAM plants capture the CO<sub>2</sub> and store it in their tissues overnight, making it available to the photosynthetic pathway during the day.

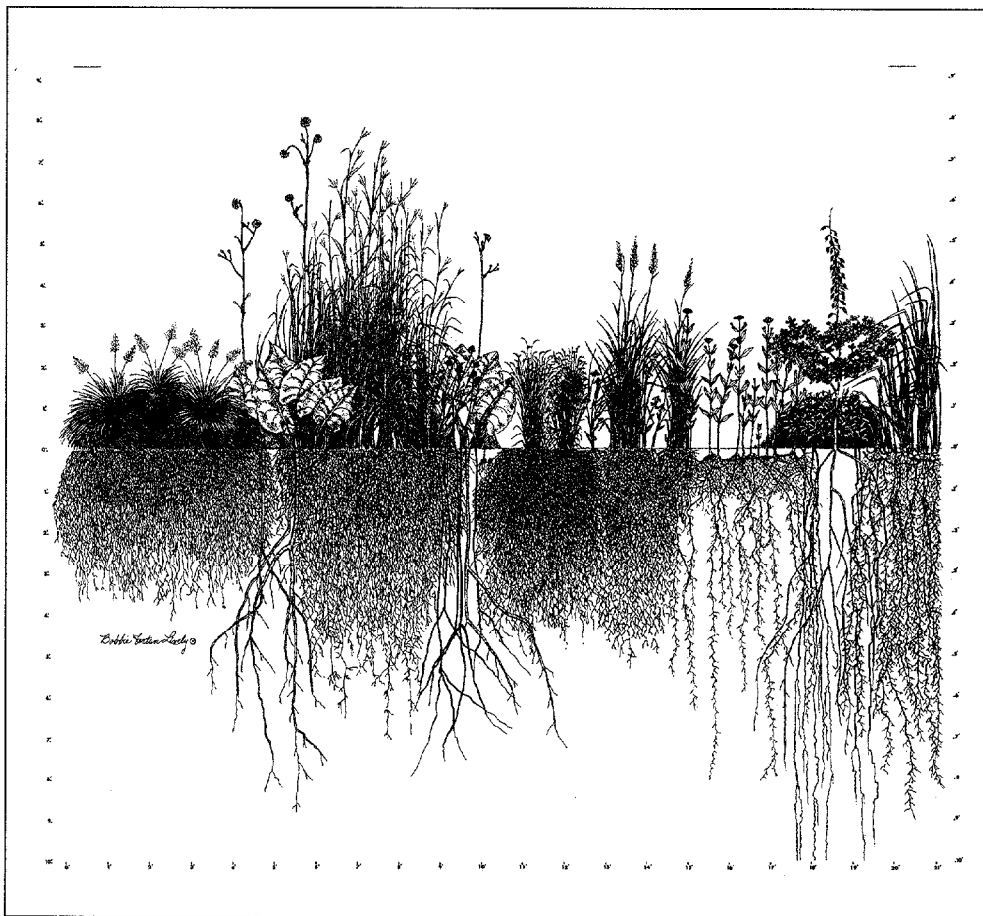
Behavioral responses to dry conditions can be dramatic and seem almost instantaneous. Yesterday, while spending time with a class of university students in a maple woods, we watched a patch of sunlight hit a cluster of jewelweed, *Impatiens capensis*.

Within a few minutes the plants began to wilt. The petioles bent down and the leaves folded and curled inward. The effect was to reduce the exposed leaf surface. Later, when the plants were again in the shade, the petioles came up, the leaves expanded, and things were back to "normal". Many plants respond in this way. Others, such as many prairie grasses, curl the edges of their leaves to reduce the surface ☘

## **FYI:**

*Roadside Use of Native Plants*, is being reprinted this summer by Island Press.

The books will be available soon. To order, please call (800) 828-1302 or email [orders@islandpress.org](mailto:orders@islandpress.org). The price of the book is \$25.00 plus shipping and handling of \$5.75 for the first book and \$2.00 for additional books. Quantity discounts are available. Bulk orders must be prepaid (government agencies may submit purchase orders).



Bobby Lively shows how drought-tolerant plants compete for water.

# THE HYDROLOGY OF DROUGHT

"Drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizable area." (USGS,2000)

What causes drought? A dry period that causes water-related problems is known as drought.

Where the rain or snow falls, how much falls, and when it falls are all variables in this answer.

When precipitation is less than normal for a period of weeks, months, or years, in a given area

river, reservoir, water table and well water levels fall. This might happen over a few weeks as in seasonal droughts predictable during the heat of summer. OR drought can occur over periods of years as in 1930 to 1941 - the Dust Bowl. A period of low rainfall does not always result in drought. However if abundant sunlight, low humidity, high temperatures and wind persist, causing high evapotranspiration, soils will lose moisture resulting in drought. Many States in the Midwest, the West and the

Southeast are in severe to extreme drought condition as you read this article. Check the Long Term Palmer map to note the condition of your region. ([www.drought.noaa.gov/palmer](http://www.drought.noaa.gov/palmer))

Why doesn't the drought go away when it rains? Good question. Just as an illness does not go away as soon as you take a single dose of medicine, neither will a single rainstorm break a drought condition. An entire system has to be cured...in this case an hydrology system. Soaking rains are the best medicine. Water must recharge the ground water system which in turn sustains vegetation. Even then, a return to normal rainfall patterns and amounts must occur or the drought condition will reappear.

What is the Palmer Index and Why should you care? I have been watching the Index since April 22 and have noted the signs of drought that have now affected many States. If your work includes planting, controlling weeds, or any form of land management, consideration of drought is important. Note the Steve Dewey

article and your maintenance work plans should be changing. What you did last year does not apply to this year, a drought year in many parts of the country. Drought should delay planting projects and weed control projects as well.

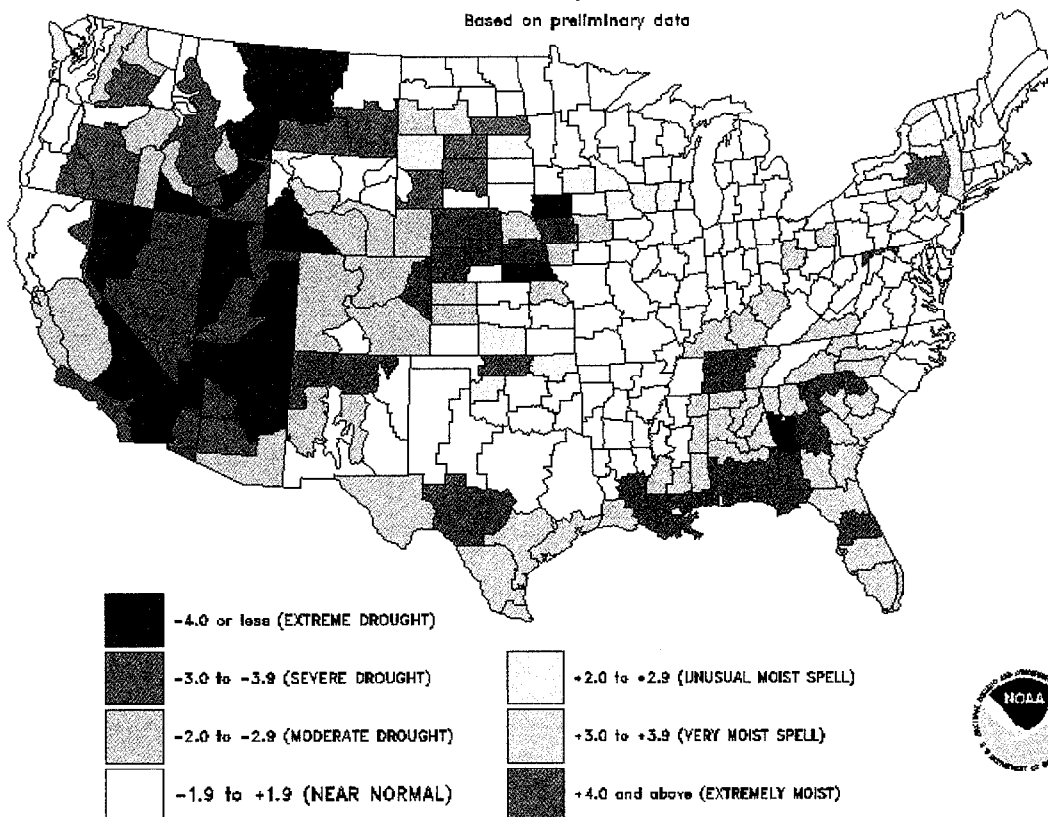
The Palmer Drought Severity Index was developed by the U.S. Weather Bureau in the 1960's. It uses temperature and rainfall information to determine dryness. It is most effective in predicting long term drought, several months or more. The advantage of the Index is that it is standardized to local climate and can be applied to any part of the country. Wayne Palmer's Crop Moisture Index (CMI) is a formula that responds from week to week and can calculate moisture conditions affecting agriculture.

NOTE: Check [WWW.USGS.Drought Watch](http://WWW.USGS.Drought Watch) for more information. This site gives regional conditions with predicted outlooks. ☺

## DROUGHT SEVERITY INDEX BY DIVISION (LONG TERM PALMER)

JUL 1, 2000

Based on preliminary data



CLIMATE PREDICTION CENTER, NOAA

# DROUGHT LOOKS LIKE

Here is what the drought looked like in the 1930's. Through improved care of the land, conservation, we hope never to repeat the history described below.

"To the red country and part of the gray country of Oklahoma, the last rains came gently,

and they did not cut the scarred earth. The plows crossed and recrossed the rivulet marks. The last rains lifted the corn quickly and scattered weed colonies and grass along the sides of the roads so that the gray country and the dark red country began to disappear under a green cover. In the last part of May the sky grew pale and the clouds that had hung in high puffs for so long in the spring were dissipated. The sun flared down on the growing corn day after day until a line of brown spread along the edge of each green bayonet. The clouds appeared, and went away, and in a while they did not try any more. The weeds grew darker green to protect themselves, and they did not spread any more. The surface of the earth crusted, a thin hard crust, and as the sky became pale, so the earth became pale, pink in the red country and white in the gray country.

.....The dawn came, but no day. In the gray sky a red sun appeared, a dim red circle that gave

a little light, like dusk; and as that day advanced, the dusk slipped back toward darkness, and the wind cried and whimpered over the fallen corn." (John Steinbeck, *The Grapes of Wrath* 1939)

## IN 2000 DROUGHT LOOKS LIKE

Excerpts from an article by Sharon Cohen, Associated Press

Star Tribune, June 25, 2000

Per a recent Associated Press report, "It is unlikely, experts say, that a full reprieve will come this summer for the drought that has broken century-old records in parts of the South.....and in other parts of the Midwest, and West.

**Nebraska looks like** - "The wheat fields that should be tall enough to tickle his chest didn't reach his knees. The soil that should be soft as a sponge was hard as concrete. And the harvest he should be planning was canceled - for lack of rain."

**Florida looks like** - "The drought has produced sinkholes, crop disasters and wildfires that have burned nearly 140,000 acres".

Montana looks like - "The snowpack is all but

gone from the mountains; some reservoirs are running short, and pastures are brown, despite recent rains and cooler temperatures that brought some relief."

**Georgia looks like** - "The third straight year of extremely dry weather has threatened endangered mollusks and aquatic life, depleted streams and reduced rives to record lows. Alligators will be on the move" seeking deeper pools of water. Tough water-use restrictions across the State have farmers worried about continued use of irrigation systems.

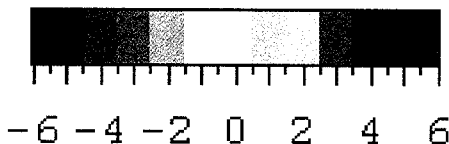
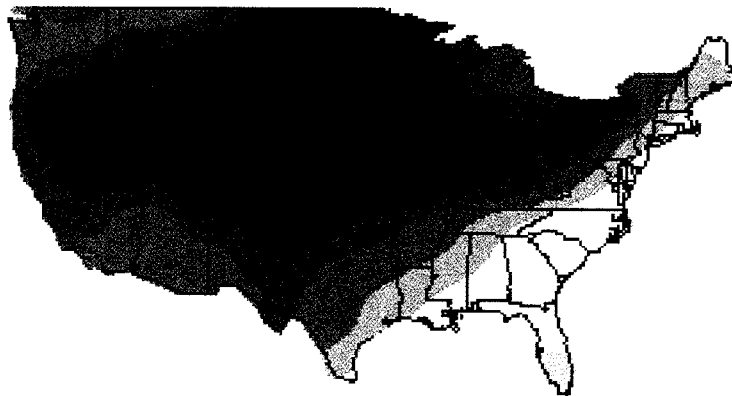
**Texas looks like** - "Goat and sheep producers are selling off their herds and state agriculture officials say wheat production is down 42 percent."

The AP points out that "drought is not just a farmer's heartache." This drought ripples through the economy from the corner grocery to commodity markets; from small town's water supply to a big city's tourism. On average, drought costs the U.S. economy \$7 to \$9 billion a year. In the 1988 dry spell, the cost was \$39 billion.

## Historic Variations in Moisture Availability

In the southwestern United States interannual

1934



In 1934, a severe drought affected most of the United States and caused extreme agricultural and economic hardship. The southern Great Plains region was particularly hard hit, and resulted in severe dust storms, reactivation of sand dunes, loss of production land widespread abandonment of farms.

# DROUGHT LOOKS LIKE

variability of moisture may be extreme. The Palmer Index (Palmer, 1965) quantifies the scope, severity, and frequency of prolonged periods of unusually dry or wet weather. The Palmer Index is based on moisture balance values that include information on precipitation, surface soil moisture (availability and loss), evapotranspiration, surface moisture, and recharge, and assumes no surface run-off or run-on. Newman (1987) points out that the Palmer Index is used as a management tool for government (i.e. urban water systems), industry (i.e. water shortages that affect the economy), and agriculture (i.e. soil moisture for growing crops).

Cook and others from NOAA have put together a Palmer Drought Severity Index (PDSI) of

instrumental drought data (1895-1995) as well as tree-ring data (1700-1978).

Shown here are two extreme cases for the United States where reds are severe drought conditions and blues indicate very wet conditions (on a scale of -6 to 6). The southwest is most susceptible to drought events as shown on a 45-year composite map

In 1934 a severe drought affected most of the United States and caused extreme agricultural and economic hardship. The southern Great Plains region was particularly hard hit, and resulted in severe dust storms, reactivation of sand dunes, loss of productive land and widespread abandonment of farms.

Conversely, 1983 was extremely wet in the

southwestern United States and coincided with a strong

Water, which is so essential to life, can be monitored by the PDSI. This can help policy makers, industry and farmers make appropriate decisions for the times.

Newman, J.E. 1987. Palmer index. in *The Encyclopedia of Climatology*. Oliver, J.E. and R.W. Fairbridge (eds.) Van Nostrand Reinhold Company, New York.

Palmer, W.C., 1965. Meteorological drought. Weather Bureau Research Paper No. 45. ☺

## DRIER THAN NORMAL????????? WHAT DOES THIS MEAN TO VEGETATION MANAGEMENT?

Signs of drought are occurring across the nation. Whether a drought materializes or not, a discussion about what a drought is and how it affects vegetation management is worthwhile.

A simple definition is "dryness due to lack of rain". ([www.USGS.gov/drought/define](http://www.USGS.gov/drought/define))

But a bigger definition that includes the consequences of drought is more meaningful to management. "Drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizable area." Drought is not a condition that happens overnight, but during a season, or over a number of years. That complicates the identification of a drought. A dry spell is typically reported by meteorologists. If dry weather persists and water-supply problems develop, the dry period can become a drought. Then it is reported by farmers, growers, urban water systems and before you realize it, you can no longer water your lawn, wash your car, or buy affordable produce. At least that is how we become aware inside a city.

But what is happening outside the city limits and what can we do about it on highway rights-of-way? Because the roadside vegetation is also

being stressed; because roadside vegetation is used by farmers in drought situations in some States; because all the roadside problems continue come drought or high water, we continue work with some added limitations.

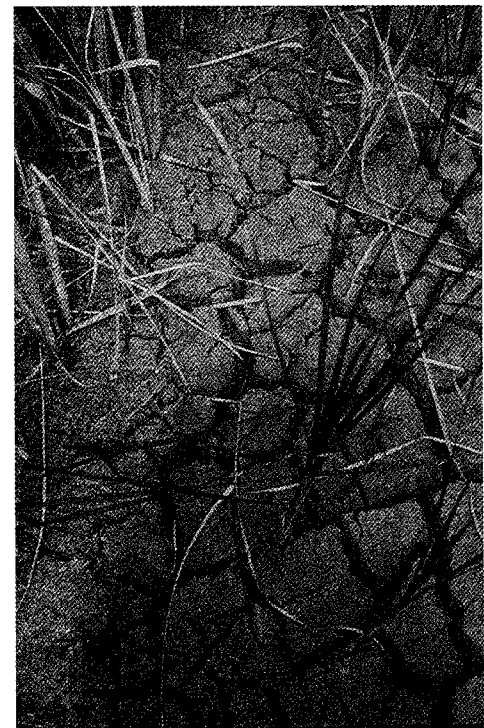
1. Less mowing and higher mowing
2. Herbicides will be volatile in high temperature, low humidity situations.
3. Burning bans will limit this management tool, and accidental fires are more likely.

Does your District seed immediately after? Be prepared.

4. Ornamental plantings should be avoided. Seedlings of drought-tolerant species can be used, because these seedlings tend to lie dormant until growing conditions are right.

But like any seeding, this will still require initial watering for germination.

As always, every location will be different. Although a shortage of rain might be common, location, soil type, hydrology, water uses, plant tolerances, weed problems will all have to be considered before drought management is



A Minnesota wetland during the dry period of 1988.

planned. This would be a good time to have a vegetation map or inventory of each roadside segment in the file. Knowing the location of existing vegetation is a beginning to any kind of management plan. ☺

# WHEN FARMERS MOW RIGHTS-OF-WAYS

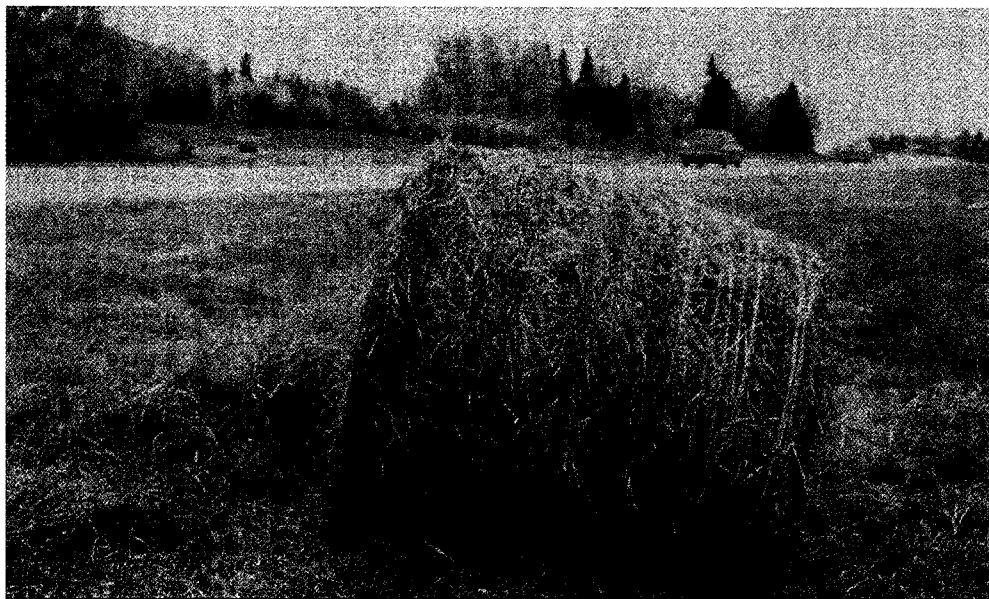
Sometimes farmers are allowed to mow roadsides during periods of drought. The rules and regulations vary from State to State. In some agricultural States, farmers' rights to mow are actually legislated. In others, the Department of Transportation defines an accommodating policy.

Here are examples of four States' policies and the status of their drought.

Yup, they are already mowing in **Nebraska**. That means the drought is official, determined on a county by county basis! In order to mow, a permit and small fee are required. The fee is \$5.00/side per mile with a limit of 5 miles on secondary roads. On expressways the cost is \$10.00 with a limit of 5 miles. Interstate mowing is allowed at \$20.00 per side per mile with a limit of 5 miles. The permits are issued on a first come-first served basis. Dick Gray reports that a legislated committee, Climate Access Response (CARC) keeps the Governor informed about the situation. The release of roadside hay is triggered by a request from this committee. The request usually parallels the counties that have a federal drought designation. As of this writing, all counties south of the Platte River (the southern half of the State) have been released.

At one District's yard, hay buyers were lined up as early as 3:30 am. As Dick says, "By noon the first day 1/4th of the roadside was sold. We have good hay. (We) have spent the best part of 38 years converting most of the roadsides to a mixture of warm and cool season grasses." They replaced what used to be brome and alfalfa.

Although **Wisconsin** is not officially in drought at this time, I checked with Dick Stark to learn about their procedure. Dick said they have no formal policy. When the Governor declares a drought emergency, the DOT will permit mowing. In the past they have had very few takers. They allow mowing only on non controlled



Some States permit farmers to harvest roadside during periods of drought.

access roadways. They do not allow harvesting on the Interstate system. Non controlled access highways in Wisconsin tend to have narrow roadsides, often with difficult terrain and the hidden trash that will cause havoc with farm mowers and therefore the harvest is not worth the effort or maintenance costs.

On the Palmer Index Map, **Montana** appears to be in moderate to Severe drought. So I called Phil Johnson of the Montana DOT to learn how they are handling the situation. Phil reported that streams are at mid summer condition (a bit low), the winter wheat did not do well, but the spring wheat is "looking good". Due to two weeks of rain things are "greening up". However, they do have a drought policy, if the trend reverses. No-cost permits are granted at the DOT District level. The permits insist on following safety regulations. Primarily the haying is done on Interstate rights-of-way in Montana because those corridors are smooth enough to accommodate farm equipment. Phil explained that his State normally experiences drought in 3 out of 10 years. These dry cycles are a way of life in Montana. He observed that

dry land hay farmers were allowed to mow their CRP land a couple weeks ago - only one sign of drought. Irrigated hayfields are not in trouble. He is carefully watching some of his seeding projects which "look good" so far; but the summer dry season is about to begin.

"It is extremely dry, reports Ray Dorsey from the **Georgia** DOT. Some parts of Georgia are 35 inches below normal. Most of the roadside wildflowers have faded out with the exception of butterfly weed which seems to thrive in these conditions" Currently no harvesting of hay is permitted on Georgia rights-of-way. If it were, little or no hay exists to harvest this year. The DOT has suspended some mowing operations due to the lack of rain.

By these examples, it is clear that every State has defined its policy based on its own weather patterns, terrain, and legislation. If you are experiencing drought in your area, be sure to check with your DOT's local office to learn what mowing is and is not allowed during a drought year. ☺

## PROPOSAL DEADLINES:

### **TERP - Transportation Environmental Research Program**

[www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp)

\$20-50,000 awards for 1 to 2 year work plans. Focused, local investigations that are based on small scale research. Proposals accepted throughout year with awards made when funds available. Some 18 topics including: vegetation management, water quality, wetlands, ecosystems, cultural resources, etc. TERP manager @410.492.2362.

### **SBIR - Small Business Innovations Research Program**

[www.volpe.dot.gov/sbir](http://www.volpe.dot.gov/sbir)

R&D projects funded at small companies. SBIR 2000 program solicitations are due on May 1, 2000. This years topics include 00-FH12 "Development of technology to increase native seed sources"

### **Transportation Enhancement (TEA-21)**

[www.enhancements.org](http://www.enhancements.org)

Funding. Each State program is different and applying for TE funds is competitive. Eligible projects include: landscaping and beautification, historic preservation, highway runoff mitigation, wildlife under-crossings, and more. For more information call 202.366.0106.

### **INVASIVE SPECIES RFP:**

Proposals that involve research, education, and outreach aimed at invasive species prevention/control and restoration of natives are solicited by USDA's John J. Obrycki at (202) 401-1108. Favored proposals are those from partnerships of multiple States, disciplines, or institutions.

### **NATIVE PLANT/HABITAT RFP:**

Proposals aimed at native plant preservation and restoration, as well as on-the-ground ecosystem approaches, are welcome. Multi-partner and multi-agency involvement encouraged. A number of grants available over the year from the National Fish and Wildlife Foundation ([www.nfwf.org](http://www.nfwf.org)). Call Gary Kania, (202) 857-0166 for information.

## **Make Plans Now!**

The mid-year meeting of the Landscape and Environmental Design Committee - Committee A2A05 of the Transportation Research Board will be July 30 to August 2 in Oklahoma City, Oklahoma. The meeting will be held at the Westin Hotel. Make plans and reservations early to take advantage of low prices. For information, contact Laurie Stillings at (405) 521-4037.

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